

WHAT IS CLAIMED IS:

1. An illumination switching apparatus  
comprising:

an objective having a numerical aperture which  
5 enables total reflection illumination to be performed  
on a target;

a light source section which outputs illumination  
light;

an illumination system which receives, the  
10 illumination light output from the light source section  
and guides it to the objective; and

an illumination switching section which selects  
one of a first optical path and a second optical path,  
when the first optical path is selected, the  
15 illumination light output from the light source section  
being guided through the illumination system to  
transmit along an optical axis of the objective and  
illuminate the target in a standard observation mode,  
when the second optical path is selected, the  
20 illumination light output from the light source section  
being guided through the illumination system and the  
objective to illuminate the target in a total  
reflection observation mode.

2. The illumination switching apparatus according  
25 to claim 1, wherein the illumination switching section  
switches between illumination of the target using  
standard observation light, performed by guiding the

illumination light through the first optical path, and illumination of the target using total reflection observation light, performed by guiding the illumination light through the second optical path.

5           3. The illumination switching apparatus according to claim 1, wherein:

the light source section includes at least two light sources; and

the illumination switching section includes:

10               a light transmission section which guides the illumination light output from one of the light sources to the first optical path, and guides the illumination light output from the other of the light sources to the second optical path; and

15               at least two shutter mechanisms provided across the first and the second optical path, the at least two shutter mechanisms cooperating to allow the illumination light to transmit through one of the first and the second optical path, and to interrupt the illumination light to transmit through the other of the first and the second optical path.

20           4. The illumination switching apparatus according to claim 3, wherein:

the light sources have respective laser oscillators which output respective laser beams; and

25               the shutter mechanisms are attached to the respective output terminals of the laser oscillators.

5        5.    The illumination switching apparatus according to claim 3, wherein the shutter mechanisms have respective mechanical shutters which are mechanically opened and closed, or respective electronic shutters which are electronically opened and closed.

10       6.    The illumination switching apparatus according to claim 3, further comprising a shutter controller which opens one of the shutter mechanisms and closes the other shutter mechanism when the target is observed using standard fluorescent light, the shutter controller closing the one shutter mechanism and opening the other shutter mechanism when the target is observed using total reflection of fluorescent light.

15       7.    An illumination switching apparatus comprising:

        an objective having a numerical aperture which enables total reflection illumination to be performed on a target;

20        a first light source which outputs first illumination light;

        at least one second light source which outputs second illumination light;

25        an illumination system which receives the first or second illumination light and guides it to the objective;

        a first light transmission section which guides the first illumination light, output from the first

light source, to a first optical path, the first optical path being formed in the illumination system to guide the first illumination light along an optical axis of the objective;

5           a second light transmission section which guides the second illumination light, output from the second light source, to a second optical path, the second optical path being formed in the illumination system to realize the total reflection illumination on the  
10       target;

          a first illumination switching section which allows the first illumination light output from the first light source to be guided to the first light transmission section, or interrupts the first  
15       illumination light; and

          a second illumination switching section which allows the second illumination light output from the second light source to be guided to the second light transmission section, or interrupts the second  
20       illumination light.

8. The illumination switching apparatus according to claim 7, wherein;

          the first illumination switching section has a first shutter mechanism which allows the first  
25       illumination light output from the first light source to be guided to the first light transmission section, or interrupts the first illumination light; and

the second illumination switching section has a second shutter mechanism which allows the second illumination light output from the second light source to be guided to the second light transmission section, or interrupts the second illumination light.

9. The illumination switching apparatus according to claim 8, wherein:

the first and the second light source have respective laser oscillators which output respective laser beams; and

the first and the second shutter mechanism are attached to the respective output terminals of the laser oscillators.

10. The illumination switching apparatus according to claim 9, wherein the first and the second shutter mechanism have respective mechanical shutters which are mechanically opened and closed, or respective electronic shutters which are electronically opened and closed.

11. The illumination switching apparatus according to claim 9, further comprising a shutter controller which opens the first shutter mechanism and closes the second shutter mechanism in a standard illumination observation mode, the shutter controller closing the first shutter mechanism and opening the second shutter mechanism in a total reflection illumination observation mode.

12. The illumination switching apparatus according to claim 9, wherein the laser oscillators output laser beams of different wavelengths.

5 13. The illumination switching apparatus according to claim 7, wherein the first light transmission section includes a first optical fiber which transmits the first illumination light, and a first light emission section which guides the first illumination light, transmitted from the first optical fiber, to the  
10 first optical path of the illumination system.

14. The illumination switching apparatus according to claim 7, wherein the second light transmission section includes a second optical fiber which transmits the second illumination light, a second light emission  
15 section which outputs the second illumination light, transmitted from the second optical fiber, and an optical element which deflects the second illumination light output from the second light emission section, thereby guiding the second illumination light to the  
20 second optical path of the illumination system.

15. The illumination switching apparatus according to claim 14, wherein the optical element has a small total reflection mirror.

25 16. The illumination switching apparatus according to claim 14, wherein the optical element has a total reflection microprism.

17. The illumination switching apparatus according

to claim 7, wherein the first light transmission section includes a first optical fiber which transmits the first illumination light, a first light emission section which outputs the first illumination light, transmitted from the first optical fiber, and an optical element which deflects the first illumination light output from the first light emission section, thereby guiding the first illumination light to the first optical path of the illumination system.

10           18. The illumination switching apparatus according to claim 17, wherein the optical element has a small total reflection mirror.

15           19. The illumination switching apparatus according to claim 17, wherein the optical element has a total reflection microprism.

20           20. The illumination switching apparatus according to claim 7, wherein the second light transmission section includes a second optical fiber which transmits the first illumination light, and a second light emission section which guides the second illumination light, transmitted from the second optical fiber, to the second optical path of the illumination system.

25           21. The illumination switching apparatus according to claim 14, wherein the second light emission section and the optical element are integrally movable in a direction parallel to an optical axis of the illumination system.

22. The illumination switching apparatus according to claim 21, wherein the optical element has a small total reflection mirror.

5 23. The illumination switching apparatus according to claim 21, wherein the optical element has a total reflection microprism.

24. The illumination switching apparatus according to claim 20, wherein the second light emission section is movable in a direction perpendicular to an optical  
10 axis of the illumination system.

25. The illumination switching apparatus according to claim 1, wherein:

the light source section has a laser oscillator which output a laser beam; and

15 the illumination switching section includes:

a beam splitter which branches the laser beam, output from the laser oscillator, in two directions;

20 a first shutter mechanism and a second shutter mechanism provided at respective branched optical paths of the beam splitter;

a first light transmission section which guides the illumination light, having passed through the first shutter mechanism, to a first optical path  
25 formed in the illumination system; and

a second light transmission section which guides the illumination light, having passed



through the second shutter mechanism, to a second optical path formed in the illumination system.

26. The illumination switching apparatus according to claim 25, wherein the beam splitter is provided at  
5 the laser output terminal of the laser oscillator, and the first and the second shutter mechanism are provided close to the beam splitter.

27. The illumination switching apparatus according to claim 25, further comprising a plurality of  
10 wavelength converting sections provided across the respective branched optical paths of the beam splitter for converting a wavelength of the laser beam into a desired value.

28. The illumination switching apparatus according to claim 25, wherein the laser oscillator outputs laser  
15 beams of different wavelengths.

29. An illumination switching apparatus comprising:

an objective having a numerical aperture which  
20 enables total reflection illumination to be performed on a target;

a first laser oscillator which outputs a first laser beam;

a second laser oscillator which outputs a second  
25 laser beam;

an illumination system which receives the first or second laser beam, and guides it to the objective;

a first shutter mechanism provided at a laser output terminal of the first laser oscillator;

a second shutter mechanism provided at a laser output terminal of the second laser oscillator;

5           a first optical fiber which transmits the first laser beam having passed through the first shutter mechanism;

          a first laser emission section which emits the first laser beam transmitted through the first optical  
10       fiber;

          a total reflection microprism provided across a first optical path formed in the illumination system for guiding light along an optical axis of the objective, the total reflection microprism reflecting  
15       the first laser beam, emitted from the first laser emission section, such that the first laser beam transmits through the first optical path;

          a second optical fiber which transmits the second laser beam having passed through the second shutter  
20       mechanism;

          a second laser emission section provided across a second optical path formed in the illumination system for illuminating the target using total reflection of light, the second laser emission section guiding the  
25       first laser beam, transmitted through the second optical fiber, to the second optical path; and

          a shutter controller which opens the first shutter

mechanism and closes the second shutter mechanism in a standard illumination observation mode for the target, the shutter controller closing the first shutter mechanism and opening the second shutter mechanism in a total reflection illumination observation mode for the target.

30. An illumination switching method comprising:
- causing a first shutter mechanism provided at a laser output terminal of a first laser oscillator to pass therethrough or interrupt a first laser beam output from the first laser oscillator;
  - causing a second shutter mechanism provided at a laser output terminal of a second laser oscillator to pass therethrough or interrupt a second laser beam output from the second laser oscillator;
  - guiding the first laser beam, having passed through the first shutter mechanism, along an optical axis of an objective via an illumination system, thereby illuminating a target by standard observation fluorescent light; and
  - guiding the second laser beam, having passed through the second shutter mechanism, through the objective via the illumination system, thereby illuminating the target using total reflection of observation fluorescent light.